Counteracting Systemic Bias in the Lab, Field, and Classroom

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Abstract

Grappling with systemic discrimination and bias in geosciences can be overwhelming to the point that one may feel powerless to fix them. Despite the sweeping nature of this challenge, faculty, principal investigators, and other scientists with leadership roles have unparalleled power to mitigate harm in environments they oversee. Here, we identify ways that scientists in these roles can immediately address bias in three common spaces — the lab, field, and classroom. We highlight key actions that can be taken to improve the quality of life of marginalized students and other trainees quickly, while important but comparatively slow institutional changes proceed.

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Keywords: diversity, inclusion, equity, principle investigator, systemic bias

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Thank you for your interest in this paper. This manuscript has been **accepted for publication** in ***AGU Advances*** as of **February 17, 2021**, and represents the revised version after peer review.

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Although *AGU Advances* is a gold open access journal, we have elected to make our manuscript available on ESSOAr to provide readers with early access. We welcome you to contact the lead author, **Emily H. G. Cooperdock** (`cooperdo[at]usc[dot]edu`), with any comments or feedback.

Sincerely,

Emily H. G. Cooperdock
Christine Y. Chen
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Highlights:

- Scientists in leadership roles can immediately address systemic bias in their spheres of influence.
- We present actions that can reduce harm and increase inclusion in the lab, the field, and the classroom.
- We call on all scientists to personally engage with research on anti-oppressive practices and translate it into sustained action.

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Grappling with systemic discrimination and bias in geosciences can be overwhelming to the point that one may feel powerless to fix them. Despite the sweeping nature of this challenge, faculty, principal investigators, and other scientists with leadership roles have unparalleled power to mitigate harm in environments they oversee. Here, we identify ways that scientists in these roles can immediately address bias in three common spaces — the lab, field, and classroom. We highlight key actions that can be taken to improve the quality of life of marginalized students and other trainees quickly, while important but comparatively slow institutional changes proceed.

1 Introduction

Events in 2020, including the killings of George Floyd, Breonna Taylor, and others, ignited a global conversation across all sectors of society about racism, white supremacy, and other systems of oppression experienced by marginalized groups. The geoscience community has responded with statements, reading groups, and committees addressing the overall lack of diversity, equity, and inclusion within our field. The sad truth is that our community has discussed its lack of diversity, particularly related to race and gender, for decades with few measurable improvements (Bromery et al., 1972; Bernard and Cooperdock, 2018). This lack of diversity, which spans race, gender, disability, sexuality and other social categories, contributes directly to the lack of inclusion and equity experienced by people from marginalized groups (Dutt, 2020).

Recent efforts have focused on systemic bias — the ways in which institutional culture, norms, and procedures exclude people based on their social identity and/or background, in both intentional and unintentional ways. Several calls have been made to address this at the institutional and federal agency level (e.g., notimeforsilence.org), and many professional societies responded by updating codes of conduct and retooling other functions with a diversity lens. At the same time, faculty, principal investigators (PIs), and other scientists that manage labs, lead fieldwork, or teach students also have an important role to play. As authoritative figures of environments that people navigate on a near-daily basis, these individuals have outsized influence over the spaces where students and trainees most keenly feel the adverse impacts of systemic bias. This power to alter career trajectories is most apparent with reference letters, grades, and providing access to resources and opportunities (“gatekeeping”), but it also manifests subtly in day-to-day interactions and norms that can either support or undermine people’s sense of belonging, fulfillment, and confidence.

Here, we highlight actions for scientists supervising labs, fieldwork, and classrooms to address systemic biases that impact students and trainees, our next generation of geoscientists. While faculty and PIs are the target of this article, these ideas are relevant to any individual in a position of authority (e.g., lab managers, teaching assistants, fieldwork organizers). We focus on tractable actions that can have immediate positive impacts for marginalized community members, mitigating harm while critical but protracted progress continues at higher organizational levels (Keisling et al., 2020; Ovienmhada et al., 2020). We call on all scientists in leadership roles to personally reflect and engage with research on anti-oppressive practices

published by historians, social scientists, and education scholars, and to translate this learning into sustained, life-long action.

2 The Lab

For many, "the lab" is both the physical space and the group of people with whom we work to accomplish our scientific objectives. Lab work is central to geoscience research, education, and professional development, but bias and harassment can make laboratories exceptionally hostile spaces for under-represented groups. Hostile work environments are a primary driver for the lack of diversity in all STEM fields (Marín-Spiotta et al., 2020).

Generally, no PI intends to create a toxic lab culture. However, most receive no formal training in mentoring, group management, or on how to create spaces where people of all backgrounds and identities can succeed. Consequently, most default to familiar practices, universalizing their own experiences by mentoring and managing in ways that worked for themselves. Due to power imbalances, PIs can remain oblivious to problems with their lab culture, leading to a cycle in which labs are most hospitable to those most similar to current leadership (i.e., "affinity bias"; Dutt, 2020). This perpetuates a lack of diversity and propagates harmful supervisory practices (Hund et al., 2018).

To counteract this, PIs must come to terms with their own positionality, which is the way that one's identity and background shape one's social standing, power, and experience in an inequitable world. Part of this work involves familiarizing oneself with the barriers and dangers faced by others (e.g., Marín-Spiotta et al., 2020). For example, most white scientists probably have minimal anxiety interacting with campus security; men likely never think twice about working isolated in a room with a stranger or acquaintance; and able-bodied scientists rarely worry about the arrangement of microscopes, work benches, or walkways. Due to power imbalances, PIs can remain oblivious to problems occurring in their own labs. Without this self-work, allyship efforts risk being ineffective or even harmful, hampered by a lack of attention to power dynamics, and catering to personal comfort levels.

Armed with sufficient understanding of one's positionality, PIs should cultivate skills that will support the marginalized community members around them (e.g., bystander intervention and conflict management). To establish an inclusive lab culture, PIs can adopt anti-oppressive lab guidelines and procedures, following recommendations by leaders in these efforts (Chaudhary and Berhe, 2020; Sloan and Haacker, 2001). In mentorship, PIs must recognize that identities and sociodemographic backgrounds matter, and that embracing different modes of work and models of success promotes an environment where everyone can bring their whole selves to their research. Recruitment of underrepresented scholars is essential, but must be coupled with efforts to improve inclusion, with the latter prioritized to avoid inflicting further harm (Table 1).

3 The Field

Field trips and fieldwork are common components of geoscience training and practice. The chance to experience new geographic settings, bond with a research team, and apply knowledge first hand are aspects of the field that attract many to the discipline. However, a long history of exclusion tarnishes this space: the idea of "the field" as the domain of rugged straight white men

persists, and its endurance reflects the shameful reality that many who do not fit this archetype must contend with hostile environments involving alienation, unsafe conditions, harassment, and assault.

Certain field requirements and harmful field experiences can stifle diversity (Giles, 2020). For example, field gear costs disproportionately affect low-income students and sharing tents or bunkhouses can be exclusionary or dangerous, especially for transgender students or those with past trauma. The physical requirements associated with hiking and camping can be unsafe for those without experience and infeasible for those with disabilities. The goal here is not to remove field experiences, but to identify barriers to participation and adapt accordingly (Table 1, Gilley et al., 2015).

Fieldwork can also be a life or death situation for some, not only due to weather or terrain, but based on an individual's gender, race, and sexuality. Over 64% of surveyed women report experiencing sexual harassment and 20% experiencing sexual assault while doing fieldwork (Clancy et al., 2014). In the United States, Black people face threats of violence and even death in the outdoors and other predominantly white spaces (Lanham, 2016; Anadu et al., 2020). LGBTQ+ scientists must also contend with violence and even criminalization in many countries (Olcott and Downen, 2020). Although we cannot control societal biases, it is our responsibility to ensure the safety of every member of our group. This starts with selecting safe destinations, developing safety protocol plans based on participants' identities before travel, and ensuring safety structures are in place once there (Viglione, 2020).

Lastly, fieldwork can become more inclusive by avoiding practices like "parachute science," in which Western scientists gather data in other countries and then leave without collaborating with or investing in those communities. Researchers should meaningfully involve Indigenous and other local communities and collaborators to incorporate non-Western knowledge systems and avoid exacerbating inequalities (e.g., Maldonado et al., 2016; North et al., 2020).

4 The Classroom

Diversity in STEM decreases with every stage of professional advancement, from undergraduate through graduate programs, postdocs, and faculty. Geoscience has the most room for improvement, with the lowest ethnic and racial representation of all STEM fields at all levels (Riggs et al., 2018). Educators must acknowledge that while classrooms can be places of positive transformation, they can also be spaces of emotional toil and attrition, especially for students of color (hooks, 1994; Hurtado et al., 2011).

One way geoscience educators can promote positive experiences is through intentional anti-oppressive, intersectional course design, recognizing the interrelated ways that multiple social identities can impact opportunities (Núñez et al., 2020). For instance, instead of relying on textbook portrayals of white male geoscientists (Bush and Mattox, 2019), teachers can highlight contributions by scientists from marginalized backgrounds (Table 1). Exposing students to relatable role models inspires a sense of belonging, increasing recruitment and retention of underrepresented minorities (Hernandez et al., 2018). Designing course syllabi that contain statements on diversity and inclusion, preferred pronouns, and land acknowledgments can establish a classroom culture of inclusivity (Fuentes et al., 2020). Carefully considered

implementation of in-class community building exercises and active learning techniques designed to increase inclusivity (Cooper et al., 2021) can combat imposter syndrome, particularly for first-generation college students and those from underrepresented groups (Theobald et al., 2020). Instructors should explicitly acknowledge the exclusionary history of geology as a discipline, and incorporate complementary Indigenous perspectives on Earth processes in their teaching (Reano and Ridgway, 2015; Gibson and Puniwai, 2006).

Another way to advance equity in the classroom is to adopt principles of Universal Design. For example, recorded and closed captioned lectures allow non-native English speakers and learning-disabled students to review course content at their own pace. Incorporating scientific research projects within class assignments provides working students with an essential experience that they might not have otherwise. Developing multiple avenues to experience the field rather than creating alternative assignments for those unable to participate promotes inclusion and avoids further marginalization (e.g., Carabajal and Atchison, 2020). The COVID-19 pandemic has hastened the advent of hybrid and online courses, including virtual field trips that can achieve the same learning outcomes as in-person field trips, while improving equity in the classroom (Sima, 2020; Whitmeyer and Dordevic, 2020).

Ultimately, classroom structures that empower students of all identities to engage in their own learning should be adopted. In support of these efforts, institutions should provide and incentivize formal pedagogical training in student-centered, inclusive teaching methods.

5 Closing Thoughts

History repeatedly shows us that the core values and traditions of scientific disciplines are set by the individuals who practice it. We, as a community, must acknowledge the historical roots of systemic bias in our field: shaped by early Western naturalists, the original practice of geoscience was exclusive by design. In the 1800s, Western geoscientists dismissed knowledge generated by non-white groups in violent ways, promoting ideas about the racial inferiority of Black and Indigenous people (e.g., Pico, 2019) while also being complicit in the transatlantic slave trade, e.g., “hitch[ing] rides on slave ships” for so-called discovery (St. Onge, 2018; Wynn-Grant, 2019). Despite social progress in the following century, the exclusion of certain groups continued in the form of segregated laboratories and classrooms (e.g., Felt, 2017).

Today, marginalization and devaluation of contributions remain, not as distant history but as the continued lived experience of many scientists (Makgoba, 2020). Uprooting the systems that have prevented the full and broad participation of marginalized groups in our field is arguably the most pressing task we must confront, now and into the future (Dutt, 2021). Academic and professional reward structures must help, rather than hinder those doing the “invisible work” to implement the actions we suggest, which often falls on colleagues who belong to underrepresented groups (Jimenez et al., 2019).

No individual action we take will eradicate systemic bias overnight, but each of us bears responsibility to help transform geoscience into a safe, diverse, and accessible discipline. Analogous to the concept of anti-racism, there is no neutral position: one is either working to make spaces more inclusive and less hostile, or maintaining systems that reward privilege at the expense of marginalized communities. The suggested actions highlighted here represent only a fraction of the work needed to counteract the systemic bias built into our discipline. A safe,

185 accessible, and diverse geosciences for all will only be realized when historical injustices are
186 reckoned with and institutional structures and policies are redesigned with equity, inclusion, and
187 justice prioritized.

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189 **Table 1.** Some suggested actions that can be readily adopted to make the lab, field, and
190 classroom more inclusive.
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The Lab	**The Field**	**The Classroom**
Normalize the discussion of diversity, equity, and inclusion (DEI) and commit resources (time, money, and personnel) to DEI efforts.	Adopt and enforce codes of conduct (Nelson et al. 2017).	Show examples of diverse geoscientists (e.g., Instagram/Twitter: @diversegeologists, @geolatinas, @blackingeoscience).
Create written lab guidelines and expectations that ensures equal opportunity to information and fosters inclusivity (e.g., Chaudhary & Berhe 2020).	Create safety plans that consider those who are non-white, LGBTQ+, disabled, women, etc.; avoid work in intolerant areas (e.g., ADVANCEGeo Partnership: https://serc.carleton.edu/advancegeo/resources/field_work.html).	Plan universally accessible field trips and classroom activities; provide multiple ways to experience the field, using virtual options or other technology (www.theiagd.org).
PIs should receive formal training in skills that help promote inclusivity and justice, such as conflict management and bystander intervention.	Provide financial and material assistance for equipment and other expenditures.	Apply inclusive learning techniques that empower students to engage (hooks, 1994); include a diversity and inclusion commitment statement in the syllabus.
Apply best practices in letter reference writing to avoid racial and gender bias (e.g., Dutt et al., 2016; Berhe and Kim, 2019; University of Arizona Commission on the Status of Women 2016).	Collaborate with and recognize as co-authors local researchers (e.g., North et al., 2020).	Provide opportunities and reward trainees for learning experiential and inclusive teaching and mentoring techniques.

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Author contributions

EHGC initiated the article. All authors contributed to each section.

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